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⑬ Calcium-supplemented beverages and beverage concentrates containing low levels of sulfate.

⑭ Beverages and beverage concentrates nutritionally supplemented with significant levels of solubilized calcium and containing low levels of sulfate, preferably in combination with low levels of chloride, are disclosed. These beverages and concentrates also contain specified levels of acidic acids selected from phosphoric acid, citric acid, malic acid, fumaric acid, adipic acid, gluconic acid, and lactic acid, as well as mixtures of these acids. The particular acid systems are selected to provide the desired flavor and sourness character for the beverages and concentrates. Inclusion of low levels of sulfate/chloride in these beverages and concentrates provides a quicker onset of sourness, prevents or reduces aftertaste effects and improves the solubility of the calcium, particularly when high levels of phosphoric acid or citric acid are used. Inclusion of sulfate/chloride also prevents or reduces the precipitation and deposition of calcium salts on equipment surfaces during the pasteurization or sterilization of calcium-containing fruit juice beverages.

EP 0 301 653 A1

CALCIUM-SUPPLEMENTED BEVERAGES AND BEVERAGE CONCENTRATES CONTAINING LOW LEVELS OF SULFATE

TECHNICAL FIELD

5 This application relates to beverages and beverage concentrates for preparing same which are nutritionally supplemented with significant levels of calcium. This application particularly relates to calcium-supplemented beverages and beverage concentrates which contain low levels of sulfate, preferably in combination with low levels of chloride.

10 Dietary calcium inadequacy may be a contributing cause to osteoporosis, at least for some populations. For example, a positive correlation between calcium intake and bone mass has been found across many age groups. It has also been suggested that the level of calcium intake early in life directly influences the peak bone mass achieved at skeletal maturity.

15 During the period of late teenage to young adulthood, it has been found that a significant reduction in dietary calcium intake typically occurs. This is especially true of the female population where reduced dietary calcium intake usually happens much earlier in life compared to their male counterparts. Accordingly, females, as a class, are especially susceptible to a prolonged calcium deficit over their life span. This calcium deficit may be one reason for the greater incidence of osteoporosis in postmenopausal women.

20 Calcium can be obtained from a variety of dietary sources. The primary sources of calcium are dairy products, in particular milk. Milk provides a very valuable source of dietary calcium. However, beginning in young adulthood and continuing through later life, milk is typically not consumed in sufficient quantities by the general population to obtain needed levels of calcium. This may be caused by the unattractiveness of milk as a drink for "social occasions." Indeed, it has been found that teenage girls, and especially young adult women, generally find milk to be a socially unattractive drink, as well as too caloric and unappealing in taste.

25 To achieve greater consumption of calcium, a more appealing alternative to milk is apparently needed. This alternative must be one which is consumed in sufficient quantities to provide nutritionally beneficial amounts of calcium. Products which are consumed in great quantities by teenagers and young adults are carbonated soft drinks. Unlike milk, soft drinks can be formulated with a variety of flavors generated by natural flavor oils, flavor extracts and synthetically derived flavor materials, which may be the reason why 30 soft drinks are very attractive to this particular group. Beverages which are consumed often by the general public, especially at breakfast, are fruit juice products, particularly orange juice. Like milk, orange juice has a wholesome, nutritional image, but is generally considered to have a more appealing taste. Accordingly, soft drinks or fruit juice products nutritionally supplemented with calcium could be viewed as potential vehicles for achieving greater dietary calcium intake during this critical teenage/young adult period, and 35 throughout life as well.

35 Nutritional supplementation of soft drinks, or other non-milk beverages like fruit juice, with significant levels of calcium is not straight forward. Milk contains, on average, about 0.12% calcium by weight. Inclusion of such a high level of calcium in a soft drink or other non-milk beverage requires consideration of a number of issues.

40 One is making sure that the calcium supplemented drink has desirable taste and mouthfeel qualities. It has been found that high levels of calcium can impart significant "chalky" mouthfeel sensations to a soft drink. This has been found to be especially true for soft drinks based on high levels of citric acid as the acidulant. In addition, it has been found that high levels of calcium can cause undesirable "biting/burning" mouthfeel sensations long after the soft drink is consumed. This "after-taste" problem is especially true of 45 soft drinks based on high levels of phosphoric acid as the acidulant.

45 Another factor which must be considered is the sourness imparted by the soft drink. Calcium-containing soft drinks based on high levels of edible acids such as citric acid or phosphoric acid typically have a slower, more lingering onset of sourness. This is due to the ability of these acids to buffer the soft drink to a relatively high, though acidic pH. A quicker onset of sourness is usually desirable for certain soft drinks, in particular those having a cola-type flavor.

50 Another potential issue is precipitation of insoluble calcium salts such as calcium citrate and calcium phosphate. Stability against precipitation is a very significant problem for beverage concentrates used to

5 prepare soft drinks or other non-milk beverages like fruit juice because of the very high levels of calcium salts present. However, at even moderate concentrations in drinkable beverages, stability against precipitation of insoluble calcium salts can be important, especially on equipment surfaces during pasteurization or sterilization of calcium-containing fruit juice beverages.

BACKGROUND ART

10 U.S. Patent 4,325,975 to Lindon et al, issued April 20, 1982, discloses mineralized drinking water formulations consisting essentially of strontium ions (20-40 milligrams per liter), magnesium ions (50-100 milligrams per liter), calcium ions (60-125 milligrams per liter), and chloride ions (0.06 to 0.15 milligrams per liter). These ions are added to distilled water in the form of water-soluble salts such as the sulfates, nitrates or chlorides.

15 U.S. Patent 4,448,770 to Epting, issued May 15, 1984, discloses a dietetic beverage containing, per gallon, 30 to 50 milliequivalents of potassium ion, 5 to 10 milliequivalents of calcium ion, 1 to 3 milliequivalents of magnesium ion, and 5 to 10 ounces of sucrose. Suitable potassium salts include the sulfate, citrate, and preferably chloride salts. Suitable calcium salts include the chloride and preferably gluconate salts. The magnesium ion is preferably supplied as the magnesium chloride salt.

20 U.S. Patent 4,322,407 to Ko, issued March 30, 1982, discloses an electrolyte drink containing sodium, potassium, magnesium, chloride, sulfate, phosphate, citrate, sucrose, dextrose, ascorbic acid and pyridoxine.

25 U.S. Patent 4,384,005 to McSweeney, issued May 17, 1983, discloses compressed tablets which rapidly dissolve in water. These tablets can be used in beverage preparation. One such tablet (Example 4) is prepared from citric acid (580 grams), malic acid (70 grams), anhydrous moistener (56 grams), corn syrup (55 grams), dextrin (25 grams), and calcium sulfate (20 grams).

30 U.S. Patent 2,297,599 to Wilen, issued September 29, 1942, discloses effervescent tablets consisting of an effervescent core and an outer layer containing a therapeutic agent. One such effervescent alkalinizing tablet contains calcium gluconate, magnesium sulfate, sodium chloride and an effervescent base of sodium bicarbonate, citric acid and tartaric acid.

DISCLOSURE OF THE INVENTION

35 The present invention relates to beverages, and beverage concentrates for preparing same, which are nutritionally supplemented with significant levels of calcium. The present invention also relates to fruit juice beverages of the present invention.

40 (a) from about 0.05 to about 0.15% by weight solubilized calcium; (b) from about 0.07 to about 1% by weight of an edible acid component; (c) from about 0.02 to about 0.14% by weight sulfate; (d) up to about 0.05% by weight chloride; (e) the amount of sulfate and chloride combined being up to about 0.14% by weight; (f) an effective amount of a flavor component; and (g) an effective amount of a sweetener.

45 For the beverage concentrates of the present invention, the level of solubilized calcium is from about 0.15 to about 0.2 to about 5% by weight, the level of the acid component is from about 0.75% by weight, the level of the acid component is from about 0.06 to about 0.7% by weight, the level of sulfate is from about 0.06 to about 0.7% by weight, the level of chloride is up to about 0.25% by weight and the level of sulfate and chloride combined up to about 0.14% by weight.

50 The present invention further relates to fruit juice beverages which are nutritionally supplemented with significant levels of calcium. These fruit juice beverages comprise (a) from about 0.05 to about 0.26% by weight solubilized calcium; (b) from about 0.4 to about 4% by weight of an edible acid component; (c) from about 0.02 to about 0.1% by weight sulfate; (d) up to about 0.07% by weight chloride; (e) the amount of sulfate and chloride combined being up to about 0.12% by weight; (f) at least about 45% fruit juice; and

(g) a sugar content of from about 2 to about 16° Brix.

For fruit juice concentrates of the present invention, the level of ~~solubilized~~ calcium is from about 0.15 to about 1.30% by weight, the level of the acid component is from about 1.2 to about 20% by weight, the level of sulfate is from about 0.06 to about 0.5% by weight, the level of chloride is up to about 0.35% by weight, the level of sulfate and chloride combined is up to about 0.6% by weight, and the sugar content is from about 6 to about 75° Brix.

The fruit juice and other beverages of the present invention contain significant levels of nutritionally beneficial calcium. Inclusion of low levels of sulfate (preferably in combination with low levels of chloride) improves the solubility of calcium in these beverages, and especially concentrates for preparing these beverages, even when they contain high levels of citric acid or phosphoric acid. Certain of these beverages also have a quicker onset of sourness, even when acid systems such as citric acid or phosphoric acid are used, as well as reduced aftertaste. In addition, the sulfate/chloride reduces or prevents the precipitation and depositing of calcium salts on equipment surfaces during pasteurization or sterilization of calcium-containing fruit juice beverages.

15

A. Definitions

As used herein, the term "beverage" refers to a beverage composition which is in a single-strength, ready-to-serve, drinkable form. Beverages of the present invention typically comprise at least 80% (preferably at least 85%) water. Beverages contemplated within the scope of the present invention include both carbonated and noncarbonated forms.

As used herein, the term "beverage concentrate" refers to a beverage composition in liquid form used to prepare a drinkable beverage. Sugar-sweetened beverage concentrates within the scope of the present invention typically comprise from 30 to 70% (preferably from 40 to 60%) water. They are usually formulated to provide drinkable beverages when diluted with 2 to 4 parts by weight water.

As used herein, the term "beverage syrup" refers to a beverage concentrate which further comprises sugar. Beverage syrups typically comprise from 30 to 70% by weight sugar.

As used herein, the term "fruit juice product" refers to both fruit juice beverages and fruit juice concentrates which comprise at least about 45% fruit juice.

As used herein, the term "fruit juice beverage" refers to a fruit juice product which is in a single-strength, ready-to-serve, drinkable form. Fruit juice beverages of the present invention can be of the "full-strength" type which typically comprise at least about 95% fruit juice.

Fruit juice beverages within the scope of the present invention can include extended juice products which are referred to as "nectars." These extended juice products typically comprise from about 50 to about 90% fruit juice. Preferred extended juice products comprise from about 50 to about 70% fruit juice.

As used herein, the term "fruit juice concentrate" refers to a fruit juice product which, when diluted with appropriate amount of water, forms drinkable fruit juice beverages. Fruit juice concentrates within the scope of the present invention are typically formulated to provide drinkable beverages when diluted with 2 to 4 parts by weight water.

As used herein, the term "concentrated fruit juice" refers to fruit juice from which a portion of the water has been removed.

As used herein, the term "fruit juice materials" refers to concentrated fruit juice, plus other fruit juice materials such as fruit juice aroma and flavor volatiles, peel oils, and pectin or pomace.

As used herein, the term "fruit juice" refers to citrus juices, noncitrus juices such as apple juice, grape juice, pear juice, cherry juice, berry juice, pineapple juice, peach juice, apricot juice, plum juice, prune juice, passion fruit juice, banana juice, and mixtures of these juices.

As used herein, the term "citrus juice" refers to fruit juices selected from orange juice, lemon juice, lime juice, grapefruit juice, tangerine juice and mixtures thereof.

As used herein, the term "comprising" means various components can be conjointly employed in the beverages and beverage concentrates of the present invention. Accordingly, the term "comprising" encompasses the more restrictive terms "consisting essentially of" and "consisting of."

All amounts of fruit juice referred to herein are on a single-strength basis.

B. Calcium Levels, Acid Systems and Sulfate/Chloride Levels

The key nutritional component of the beverages and beverage concentrates of the present invention is calcium. Suitable sources of calcium include calcium carbonate, calcium sulfate, calcium chloride, calcium phosphat, calcium hydrogen-phosphate and calcium dihydrogen phosphate, calcium hydroxide, as well as the respective sour salts of calcium, e.g., calcium citrate, calcium lactate, calcium malate, calcium gluconate or calcium sulfate, which optionally and particularly preferred calcium sources. To be useful in the present invention, the calcium needs to be "solubilized", i.e., dissolved or suspended, in the beverage or beverage concentrate. Accordingly, the amount of calcium included in the beverages and beverage concentrates of the present invention will be referred to as the amount of calcium ion dissolved or suspended.

For beverages of the present invention, calcium is present in the beverage. The minimum level of calcium (about half of milk level) provides significant nutritional supplementation for fruit juice beverages and in fruit juice beverages is increased (e.g., for beverages), satisfactory taste and stability properties become much more difficult to achieve. For fruit juice beverages is from about 0.10 to 0.20% by weight which includes about 0.055 to about 0.09% by weight for other beverages.

With regard to fruit juice concentrates used to prepare fruit juice beverages of the present invention, the amount of calcium present is from about 0.15% to about 1.0% by weight. For other beverage concentrates, the amount of calcium present is typically from about 0.15% to about 0.75% by weight. Typically, beverages of the present invention are prepared from 3-fold to 5-fold (5X) beverage concentrates. Accordingly, the level of solubilized calcium is preferably in the weight for fruit juice concentrates and from about 0.16 to about 0.45% by weight for other beverage concentrates.

A key component for drinkable beverages and beverage concentrates of the present invention is the standpoint of stability against precipitation of insoluble calcium. A desirable onset of sourness is the edible acid component (additive). This additive comprises one or more edible acids, which can include phosphoric acid, adipic acid, lactic acid, tartaric acid, gluconic acid or mixtures thereof. These acids can be present in their undisassociated form or else as the respective sour salts or dihydrogen phosphate, citrate, malate, tartrate, gluconate and the like. Acid systems comprise phosphoric acid, citric acid, malic acid, gluconic acid or combinations thereof.

For the purposes of the present invention, the level of total acids depends on the beverage composition involved, the level of acids and taste and stability properties desired. For fruit juice beverages having from about 0.15% to about 1.0% by weight solubilized calcium, the level of total acids can range from about 0.05 to about 0.20% by weight. For other beverages having from about 0.15% to about 0.75% by weight solubilized calcium, the level of total acids can range from about 0.05 to about 0.15% by weight. (For fruit juice concentrates used to prepare such beverages, the level of total acids can range from about 0.05 to about 0.20% by weight.) For preferred fruit beverages having from about 0.15% to about 0.75% by weight solubilized calcium, the level of total acids preferably ranges from 0.6 to about 1.0% by weight for fruit juice concentrates used to prepare these fruit juice beverages having from about 0.055 to about 0.09% by weight solubilized calcium, the level of total acids preferably ranges from 0.1 to 0.6% by weight (from about 0.15 to about 0.75% by weight for fruit juice concentrates used to prepare these beverages).

An important component for the beverages and beverage concentrates of the present invention is the level of sulfate present. Inclusion of low levels of sulfate (e.g., chloride) in beverages of the present invention has been found to be causative of a quicker onset of sourness in certain beverages having from about 0.055 to about 0.09% by weight solubilized calcium. This is believed to be due to a reduction in the buffering capacity of the edible acids present. (Chloride is believed to aid the quicker onset of sourness due to a taste mechanism interaction.) Another important benefit of low levels of sulfate is that calcium in the beverage/ concentrate, even where high levels of calcium are used, is also believed to be due to a reduction in the buffering capacity of the edible acids present. Another benefit

ertaste associated with calcium-
to be due to delayed precipitation
ate/chloride inclusion is believed
ation-in-pH.

5 For fruit juice beverages having from about 0.05 to about 0.26% by weight of sulfate can range from about 0.02 to about 0.1% by weight, while the chloride level can range from about 0.07% by weight. (For fruit juice concentrates used to prepare beverages, the sulfate level can range from about 0.06 to about 0.5% by weight, while the chloride level can range from about 0.35% by weight.) For other beverages having from about 0.05 to about 10 0.14% by weight of calcium, the level of sulfate can range from about 0.02 to about 0.14% by weight, while the chloride level can range up to about 0.05%. (For beverage concentrates used to prepare beverages, the sulfate level can range from about 0.06 to about 0.7% by weight, while the chloride level can range from about 0.25% by weight.) At sulfate levels much above 0.10% by weight, or chloride levels much above 0.07% by weight, in juice beverages (above 0.14% by weight or 0.05% by weight, respectively), the sulfate and chloride concentrations are sufficiently high to note which is considered undesirable. At sulfate levels much below 0.05% by weight, the taste is sourness, aftertaste and improved solubility of calcium is significantly reduced. The combined amount of sulfate and chloride should be no more than about 0.12% by weight in the present invention, and no more than about 0.6% by weight in other beverages. The combined amount of sulfate and chloride should be no more than about 0.10% by weight, and no more than about 0.5% by weight for beverage concentrates used to prepare 15 20 beverages.

Sources of sulfate and chloride for inclusion in beverages and invention can be from sulfuric acid or hydrochloric acid, or salts 25 chloride. Preferably, the sulfate and chloride are derived from calcium also serve as at least partial sources of calcium. Calcium sulfate and from about 3.2 to 100% by weight of the solubilized calcium for fruit about 5.6 to 100% by weight of the solubilized calcium for other calcium sulfate and calcium chloride combined supply from about 30 calcium present in fruit juice beverages/concentrates and from about 9. present in other beverages/concentrates.

age concentrates of the present as calcium sulfate and calcium sulfate and calcium chloride, which calcium chloride combined can supply beverages/concentrates and from beverages/concentrates. Preferably, to about 60% of the solubilized to 89% of the solubilized calcium

C. Other Components of Beverages and Beverage Concentrates

35

1. Fruit Juice Beverages and Juice Concentrates

40 The fruit juice beverages and juice concentrates of the present invention are normally present in fruit juice products. These sugars include sucrose, glucose, invert sugar, and mixtures thereof. The amount of sugar need not be sufficient for the calcium-supplemented fruit juice beverages and invention. However, in the case of extended juice products, sugar is

45 sucrose or high fructose corn syrup.

In addition to sugar, extended fruit juice beverages of the sweeteners. Other suitable sweeteners include saccharin, cyclophenylalanine lower alkyl ester sweeteners (e.g. aspartame), L-aspartic acid Patent 4,411,925 to Brennan et al. issued October 23, 1983 (herein incorporated by reference), L-aspartyl-L-1-hydroxymethylalkaneamide 4,338,346 to Brand, issued December 21, 1982 (herein incorporated by reference), ethylalkaneamide sweeteners disclosed in U.S. Patent 4,423,029 (herein incorporated by reference), L-aspartyl-D-phenylglycine ester and amide Patent Application 168,112 to J. M. Janusz, published January 15, 1985 and the like. A particularly preferred sweetener for use in such extended fruit juice beverages is aspartame.

For single-strength fruit juice beverages, the sugar content can vary. Typically, the sugar content of such beverages depends upon the

vention also contain the sugars sucrose, high fructose corn syrup, or present in fruit juices is usually in concentrates of the present usually added, usually in the form of

ent invention can contain other sweeteners, acetosulfam, L-aspartyl-L-alanine amides disclosed in U.S. Patent 4,409,382 (herein incorporated by reference), L-aspartyl-L-alanine amides disclosed in U.S. Patent 4,409,383 (herein incorporated by reference), L-aspartyl-1-hydroxy-3,5-dihydro-4H-1,2-dihydro-4-oxo-5-thiopyran-2-one, issued August 16, 1983 (herein incorporated by reference), L-aspartyl-1-hydroxy-3,5-dihydro-4H-1,2-dihydro-4-oxo-5-thiopyran-2-one, issued Dec. 27, 1983 (herein incorporated by reference), sweeteners disclosed in European Patent 110,000 (herein incorporated by reference), sweeteners disclosed in European Patent 110,001 (herein incorporated by reference), and the products is aspartame.

from about 2 to about 16° Brix.
of fruit juice contained therein.

For full-strength beverages containing at least about 95% fruit juice, the sugar content is typically from about 5 to about 14° Brix. For extended juice beverages which comprise from about 50 to about 90% fruit juice, the sugar content is typically from about 5 to about 13° Brix (no other sweetener) or from about 2 to about 8° Brix (other sweetener containing).

5 For fruit juice concentrates according to the present invention, the sugar content can range from about 6 to about 75° Brix. Typically, the sugar content of these juice concentrates is from about 20 to about 50° Brix. For orange juice concentrates, the sugar content is preferably in about 35° to about 50° Brix.

The fruit juice beverages and juice concentrates of the present invention are typically substantially free of added protein. Examples of such proteins include soy protein, whey protein concentrate, and the like.

10 These proteins can react with fruit juice aromas and flavors to, if hydrolyzed, can form short-chain peptides or amino acids which have undesirable bitter flavors. In fruit juice beverages of the present invention, the amount of added protein is generally no more than about 0.1% by weight. Preferably, these beverages and concentrates contain no added protein.

15 Other optional ingredients typically present in fruit juice products can be included in the beverages and concentrates of the present invention. For example, preservatives, vitamins and other minerals can be included. Suitable vitamins include A, D, E, C (ascorbic acid), B₁ (thiamin), B₂ (riboflavin), B₆, B₁₂, niacin, folic acid and biotin. Other minerals besides calcium which can be included are iron, zinc, potassium, magnesium, manganese and copper. If desired, natural and/or synthetic flavorings and colorings can be included in these beverages and concentrates.

20

2. Other Beverages and Beverage Concentrates

25

a. Flavor Component

Other beverages and beverage concentrates of the present invention typically comprise a flavor component which contains a flavor selected from fruit flavors used herein, the term "fruit flavor" refers to those flavors derived from the edible reproductive part of a seed plant, especially one having a sweet pulp associated with the flavor" are synthetically prepared flavors made to simulate fruit. Particularly preferred fruit flavors are the citrus flavors including orange and grapefruit flavors. Besides citrus flavors, a variety of other flavors, grape flavors, cherry flavors, pineapple flavors and the like, natural sources such as fruit juices and flavor oils, or else synthetically prepared.

30 As used herein, the term "botanical flavor" refers to flavors derived from parts of a plant other than the fruit. As such, botanical flavors can include those flavors derived from nuts, bark, roots and leaves. Also included within the term "botanical flavor" are synthetically prepared flavors made to simulate botanical flavors derived from natural sources. Examples of such flavors include kola flavors, tea flavors, and the like. These botanical flavors can be derived from natural sources or else synthetically prepared.

35 The flavor component can comprise a blend of various flavors with citrus flavors to form cola flavors, etc. If desired, fruit juice, apple juice, grape juice and the like can be used in the flavor component. The flavor component are sometimes formed into emulsion droplets within the flavor concentrate. Because these droplets usually have a specific density, they therefore form a separate phase, weighting agents (which can be used to keep the emulsion droplets dispersed in the beverage) can be added. Examples of such weighting agents are brominated vegetable oils (BVO) and rosin esters, in part. See Developments in Soft Drinks Technology, Vol. 1, (Applied Science Publishers Ltd. 1978), incorporated by reference), for a further description of the use of such weighting agents in soft drinks. Besides weighting agents, emulsifiers and emulsifying agents can be used to stabilize the emulsion droplets. Examples of such emulsifiers and emulsifying agents are celluloses, polysorbates, sorbitan esters and propylene glycol esters.

40 The particular amount of the flavor component effective in the beverages and beverage concentrates of the present invention will depend upon the flavor(s) selected, the flavor impression desired, and the like.

45 The flavor component typically comprise a flavor component which contains a flavor selected from the edible reproductive part of a seed plant. Also included within the term "fruit flavor" are synthetically prepared flavors made to simulate fruit flavors derived from natural sources. Examples of such flavors include orange flavors, lemon flavors, lime flavors and grapefruit flavors. These fruit flavors can be derived from natural sources such as fruit juices and flavor oils, or else synthetically prepared.

50 As used herein, the term "botanical flavor" refers to flavors derived from parts of a plant other than the fruit. As such, botanical flavors can include those flavors derived from nuts, bark, roots and leaves. Also included within the term "botanical flavor" are synthetically prepared flavors made to simulate botanical flavors derived from natural sources. Examples of such flavors include kola flavors, tea flavors, and the like. These botanical flavors can be derived from natural sources or else can be synthetically prepared.

55 The flavor component can comprise a blend of various flavors with citrus flavors to form cola flavors, etc. If desired, fruit juice, apple juice, grape juice and the like can be used in the flavor component. The flavor component are sometimes formed into emulsion droplets within the flavor concentrate. Because these droplets usually have a specific density, they therefore form a separate phase, weighting agents (which can be used to keep the emulsion droplets dispersed in the beverage) can be added. Examples of such weighting agents are the ester gums. See L. F. Green, Developments in Soft Drinks Technology, Vol. 1, (Applied Science Publishers Ltd. 1978), pp. 87-93 (herein incorporated by reference), for a further description of the use of such weighting agents in soft drinks. Stabilizers can be used to stabilize the emulsion droplets. Examples of such stabilizers include the gums, pectins, celluloses, polysorbates, sorbitan esters and propylene glycol esters. See L. F. Green, supra at p. 92.

60 The particular amount of the flavor component effective in the beverages and beverage concentrates of the present invention will depend upon the flavor(s) selected, the flavor impression desired, and the like.

components which are substantially free of fruit juice, i.e., on a single strength basis, no more than about 1% fruit juice by weight of the beverage, the flavor component can comprise at least about 0.05% by weight of the beverage composition, and typically from about 0.1 to 2% by weight for carbonated beverages. When fruit juices are used, the flavor component can comprise about 40% fruit juice by weight of the beverage, preferably from about 10% to about 15% fruit juice by weight for carbonated beverages.

b. Sweeteners

10 Beverages and beverage syrups of the present invention contain used is sugar. As used herein, the term "sugar" refers to mono- and such sugars include sucrose, glucose, fructose, high fructose corn syrup. Preferred sugars are sucrose and high fructose corn syrup. Sugars have been found to enhance the absorbability/bioavailability of the invention.

15 For diet beverages, noncaloric sweeteners can be used. Examples of such sweeteners include saccharin, cyclamates, acetosulfam, L-aspartyl-L-phenylalanine lower alanine amides disclosed in U.S. Patent 4,411,925 to Brennan et al., issued October 23, 1983 (herein incorporated by reference), L-aspartyl-D-serine amides disclosed in U.S. Patent 4,399,163 to Brennan et al., issued August 16, 1983 (herein incorporated by reference), L-aspartyl-L-1-hydroxymethylalkaneamide sweeteners disclosed in U.S. Patent 4,338,346 to Brand, issued December 21, 1982 (herein incorporated by reference), L-aspartyl-1-hydroxyethylalkaneamide sweeteners disclosed in U.S. Patent 4,423,029 to Rizzi, issued December 27, 1983 (herein incorporated by reference), and the like. The acid systems of the present invention can provide improved hydrolytic stability for the phenylalanine ester (e.g. aspartame) sweeteners in the critical pH range from about 4.0 to about 4.8.

20 The amount of the sweetener effective in the beverages of the present invention depends upon the particular sweetener(s) used and the sweetness intensity desired. This amount varies depending upon the sweetness intensity of the particular sweetener(s) used. For sugar, this amount can be from about 1 to about 14% (typically from about 6 to about 14%) by weight for carbonated beverages. Preferred beverages contain from about 9 to about 13% by weight sugar for beverages of the present invention, any sugar or other sweetener present in the flavor component, such as in fruit juice, is also included.) Low-calorie sweetener combinations containing a noncaloric sweetener such as aspartame and a sugar such as high fructose corn syrup can also be used in beverages of the present invention. For beverage syrups of the present invention, the amount of sugar is significantly higher. Usually, the amount of sugar in a beverage syrup is from about 30 to about 70% by weight. Preferably, such beverage syrups contain from about 40 to about 60% by weight sugar.

25 The beverages, beverage concentrates and beverage syrups of the present invention are typically substantially free of a sugar alcohol, i.e. less than about 1% by weight. Common sugar alcohols include sorbitol, mannitol and xylitol. Sugar alcohols are sometimes used as sweeteners in food products. However, these sugar alcohols, which are noncaloric, are also metabolized by lower gut flora, causing flatulence and related gastrointestinal (GI) tract problems such as diarrhea. Accordingly, at the levels required to sweeten beverages, sugar alcohols are not particularly useful in the present invention.

30 c. pH and Other Beverage Ingredients

35 The pH of other beverages and beverage concentrates of the present invention is dependent upon the particular composition of the acid component, the total amount of acid desired. Typically, the pH can range from about 2.5 to about 5.0. The pH of from about 2.5 to about 4.5.

40 Other minor beverage ingredients are frequently included. Such ingredients include preservatives such as benzoic acid and salts thereof. Also included are colors derived either from natural sources or synthetic. 55 Developments in Soft Drinks Technology, Vol. 1 (Applied Science Publishers Ltd. 1978), pp. 185-186 (herein incorporated by reference) for preservatives and colors used in beverages.

45 The sweetener typically used is sugar. As used herein, the term "sugar" refers to mono- and such sugars include sucrose, glucose, fructose, high fructose corn syrup. Preferred sugars are sucrose and high fructose corn syrup. Sugars have been found to enhance the absorbability/bioavailability of the invention.

50 Beverages and beverage syrups of the present invention contain sweetener. The sweetener typically used is sugar. As used herein, the term "sugar" refers to mono- and such sugars include sucrose, glucose, fructose, high fructose corn syrup. Preferred sugars are sucrose and high fructose corn syrup. Sugars have been found to enhance the absorbability/bioavailability of the invention.

55 The amount of the sweetener effective in the beverages of the present invention depends upon the particular sweetener(s) used and the sweetness intensity desired. This amount varies depending upon the sweetness intensity of the particular sweetener(s) used. For sugar, this amount can be from about 1 to about 14% (typically from about 6 to about 14%) by weight for carbonated beverages. Preferred beverages contain from about 9 to about 13% by weight sugar for beverages of the present invention, any sugar or other sweetener present in the flavor component, such as in fruit juice, is also included.) Low-calorie sweetener combinations containing a noncaloric sweetener such as aspartame and a sugar such as high fructose corn syrup can also be used in beverages of the present invention. For beverage syrups of the present invention, the amount of sugar is significantly higher. Usually, the amount of sugar in a beverage syrup is from about 30 to about 70% by weight. Preferably, such beverage syrups contain from about 40 to about 60% by weight sugar.

60 The beverages, beverage concentrates and beverage syrups of the present invention are typically substantially free of a sugar alcohol, i.e. less than about 1% by weight. Common sugar alcohols include sorbitol, mannitol and xylitol. Sugar alcohols are sometimes used as sweeteners in food products. However, these sugar alcohols, which are noncaloric, are also metabolized by lower gut flora, causing flatulence and related gastrointestinal (GI) tract problems such as diarrhea. Accordingly, at the levels required to sweeten beverages, sugar alcohols are not particularly useful in the present invention.

65 The pH of other beverages and beverage concentrates of the present invention is dependent upon the particular composition of the acid component, the total amount of acid desired. Typically, the pH can range from about 2.5 to about 5.0. The pH of from about 2.5 to about 4.5.

70 Other minor beverage ingredients are frequently included. Such ingredients include preservatives such as benzoic acid and salts thereof. Also included are colors derived either from natural sources or synthetic. 75 Developments in Soft Drinks Technology, Vol. 1 (Applied Science Publishers Ltd. 1978), pp. 185-186 (herein incorporated by reference) for preservatives and colors used in beverages.

D. Preparation of Beverages and Beverage Concentrates

5. 1. Fruit Juice Beverages and Juice Concentrates

Calcium sulfate, and calcium chloride and/or calcium gluconate are used to solubilized calcium for calcium-supplemented fruit juice beverages and juice concentrates of the present invention. Other calcium sources, in particular, calcium hydroxide, calcium oxide and calcium carbonate, are also used. Calcium gluconate is typically used in addition to calcium sulfate, and calcium chloride. Other calcium sources are preferably included in these fruit juice beverages and juice concentrates. This method is referred to hereafter as a premix method. The following discussion is with regard to formation of orange juice beverages and juice concentrates and products according to the present invention. However, this method can be used to supplement fruit juice products based on other citrus juices such as apple juice, as well as mixtures of juices.

In this premix method, an acid component comprising citric acid and from about 0 to about the appropriate quantity of water. (If desired, fruit juice or concentrated fruit juice can be used to supply a portion of the acids). Generally, this acid component comprises from about 10 to about 100% by weight citric acid and from about 10 to about 100% by weight malic acid. Preferably, this acid component comprises from about 5 to about 95% by weight citric acid and from about 40 to about 95% by weight malic acid. (This acid component typically comprises from about 5 to about 95% by weight citric acid and from about 50 to about 80% by weight malic acid.) As a result, the acid component provides optimum flavor character in the juice.

Once the solution containing the dissolved acids is formed, calcium carbonate is then added. The weight ratio of total acids to calcium carbonate is then added. The weight ratio of total acids to calcium carbonate is from about 0.5 to about 12. Preferably, this weight ratio is from about 0.5 to about 10.

Addition of calcium carbonate, calcium oxide, or calcium hydroxide provides a premix containing an at least meta-stable solution of calcium citrate and calcium malate species such as calcium citrate malate, $\text{Ca}(\text{H}_2\text{citrate})_2$, and CaHmalat . Calcium carbonate is a preferred source of calcium. Without added calcium, the calcium citrate and calcium malate species tend to disproportionate to the corresponding acid and the more thermodynamically stable calcium citrate, $\text{Ca}_2\text{citrate}_2$.

To improve the stability of the calcium malate and especially the calcium citrate, it is preferred to include a premix stabilizer. Materials which can act as crystallization inhibitors are useful as premix stabilizers. These materials include sucrose, glucose, fructose, high fructose corn syrup, invert sugar, and polysaccharides such as starches, xanthan gum, and other edible gums. Concentrated juice and concentrated polysaccharides are particularly suitable premix stabilizers. For example, high fructose corn syrup (especially for extended juice products) can provide a sugar content of from about 35 to about 80° Brix whose source is sucrose.

The premix stabilizer can be added immediately after the addition of the acids to the solution containing the acids. (When calcium carbonate is used, the stabilizer is preferably added to substantially cease before the addition of the calcium source). The amount of premix stabilizer typically depends upon the stabilizer used. When polysaccharides are used, they are typically added in an amount sufficient to provide a sugar content of from about 2 to about 6° Brix. When polysaccharides are used, the amount can vary within a range of from about 0.5% on a weight/volume basis. When concentrated juice is used, the amount can vary within a range of from about 2 to about 12° Brix (preferably from about 2 to about 6° Brix).

The premix solution of solubilized calcium is typically

usually do not supply 100% of the calcium required for calcium-supplemented fruit juice beverages and juice concentrates of the present invention. Other calcium sources, in particular, calcium hydroxide, calcium oxide and calcium carbonate, are also used. Calcium gluconate is typically used in addition to calcium sulfate, and calcium chloride. Other calcium sources are preferably included in these fruit juice beverages and juice concentrates by using what is referred to hereafter as a premix method. The following discussion is with regard to formation of orange juice beverages and juice concentrates and products according to the present invention. However, this method can be used to supplement fruit juice products based on other citrus juices such as apple juice, as well as mixtures of juices.

In this premix method, an acid component comprising citric acid and from about 0 to about the appropriate quantity of water. (If desired, fruit juice or concentrated fruit juice can be used to supply a portion of the acids). Generally, this acid component comprises from about 10 to about 100% by weight citric acid and from about 10 to about 100% by weight malic acid. Preferably, this acid component comprises from about 5 to about 95% by weight citric acid and from about 40 to about 95% by weight malic acid. (This acid component typically comprises from about 5 to about 95% by weight citric acid and from about 50 to about 80% by weight malic acid.) As a result, the acid component provides optimum flavor character in the juice.

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Addition of calcium carbonate, calcium oxide or calcium hydroxide, calcium oxide or calcium hydroxide or calcium added in the solution is typically from about 0.5 to about 12. Preferably, this weight ratio is from about 0.5 to about 10. The addition of calcium to the aqueous solution of acids provides a premix containing an at least meta-stable solution of calcium citrate and calcium malate species such as calcium citrate malate, $\text{Ca}(\text{H}_2\text{citrate})_2$, and CaHmalat . Calcium carbonate is a preferred source of calcium. Without added calcium, the calcium citrate and calcium malate species tend to disproportionate to the corresponding acid and the more thermodynamically stable calcium citrate salts, such as calcium citrate, $\text{Ca}_2\text{citrate}_2$.

To improve the stability of the calcium malate and especially the calcium citrate, it is preferred to include a premix stabilizer. Materials which can act as crystallization inhibitors are useful as premix stabilizers. These materials include sucrose, glucose, fructose, high fructose corn syrup, invert sugar, and polysaccharides such as starches, xanthan gum, and other edible gums. Concentrated juice and concentrated polysaccharides are particularly suitable premix stabilizers. For example, high fructose corn syrup (especially for extended juice products) can provide a sugar content of from about 35 to about 80° Brix whose source is sucrose.

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The premix solution of solubilized calcium is typically

description above, at room temperature. However, this premix solution is also be prepared in a continuous fashion. In this continuous method, the ingredients (water, acids, stabilizer) are constantly metered together to form the premix solution. The level at which the ingredients are metered is adjusted, as necessary, to insure appropriate solution and to provide the appropriate acidity.

The premix solution containing the solubilized calcium is concentrated below about 40° F (4.4° C) concentrated orange juice having a sugar Brix (preferably from about 60 to about 70° Brix.), orange juice and/or orange juice materials such as pulp and peel oils, to provide the products. The particular proportions of premix solution, concentrated and peel oils used will depend upon a number of different factors of supplementation desired and the type of orange juice product (e.g., juice concentrate). Calcium sulfate, and calcium chloride and/or citrate can be included in the premix solution. After the product is obtained, it is then filled into cans, cartons, bottles or other calcium-supplemented orange juice concentrates, these products being.

Inclusion of calcium sulfate and calcium chloride in calcium-supplemented fruit juice beverages helps in reducing or preventing the precipitation of calcium salts (especially citrate) on equipment surfaces during pasteurization or sterilization. It has been surprisingly found that when a stream passes through pasteurization or sterilization equipment, the stream precipitate out at the high temperatures (e.g., from about 120° F to about 300° F) required for deposit on the equipment surface of product stream. Pasteurization or sterilization equipment in which such precipitation problems can occur include ultra-high temperature direct

The concentrated orange juice, orange juice aroma and flavor method of the present invention can be obtained from standard Citrus Science and Technology, Volume 2, (AVI Publishing Co. 1971 reference) for standard processing of oranges, grapefruit and tangy Vegetable Juice Processing Technology (3rd Ed., AVI Publishing Co. 1971 by reference) for standard processing of noncitrus juices such as etc. to provide sources of juice and juice materials for calcium-supplemented fruit juice. Fresh juice is extracted from the oranges, principally of the Valencias, initially rasped to provide peel oils which can be used in the method. Different oranges are frequently blended to adjust the sugar to acid ratio. 8:1 to about 20:1 is considered acceptable. However, preferred sugar to acid ratios are typically from about 11:1 to about 15:1.

Juice is extracted from the oranges by using automatic juice squeezing of the oranges. The type of equipment used to extract juice exiting from the squeezing device contains pulp, rag and seeds. The juice and pulp in a finisher. The juice is then typically separated from the pulp. (The pulp portion can be used as a source of pulp in the method of the present invention).

The serum portion can be concentrated by a variety of techniques concentration or freeze concentration. In evaporative concentration, water vapor, as well as the aroma and flavor volatiles, are stripped are then centrifuged to provide an upper layer (essence oils) and a portion of these essence oils and aqueous essence are typically used and flavor volatiles for the method of the present invention). Concentrated in the evaporator (by heat) to the appropriate amount of the concentrated juice. This concentrated juice can be used in the invention.

Most concentrated orange juices are obtained by evaporative concentration can also be used to obtain concentrated orange juice useful. Freeze concentration typically involves passing the serum portion

in a mix tank with chilled (e.g., 35° F) water from about 35 to about 80° F and flavor volatiles, plus other calcium-supplemented orange juice aroma and flavor volatiles, pulp including the degree of calcium supplementation desired (single-strength juice beverage or gluconate, can also be added to calcium-supplemented orange juice appropriate packaging. In the case of calcium-supplemented orange juice, the product is typically frozen after being filled into cans.

Inclusion of calcium sulfate and calcium chloride in calcium-supplemented fruit juice beverages helps in reducing or preventing the precipitation of calcium salts (especially citrate) on equipment surfaces during pasteurization or sterilization. It has been surprisingly found that when a stream passes through pasteurization or sterilization equipment, the stream precipitate out at the high temperatures (e.g., from about 120° F to about 300° F) required for deposit on the equipment surface of product stream. Pasteurization or sterilization equipment in which such precipitation problems can occur include ultra-high temperature direct

ultra-high temperature direct pulp and peel oils used in the processing. See Nagy et al., 177-252 (herein incorporated by reference). (See also Nelson et al., Fruit & Vegetable Juice Processing Technology, pp. 180-505 (herein incorporated by reference). (The peel of the oranges is a source of pulp in the method of the present invention). Juices from oranges have a sugar to acid ratio of from about 8:1 to about 20:1. Sugar to acid ratios are typically from about

machines, or less often by hand. The type of equipment used to extract juice is not critical. The raw juice and seed are separated from the pulp portion and a serum portion. (The pulp portion can be used as a source of pulp in the method of the present invention).

The serum portion can be concentrated by a variety of techniques which typically include evaporative concentration. The serum portion of the juice is passed through an evaporator (TASTE type). The volatiles are stripped from the juice. These stripped volatiles are then passed through a separator to provide an upper layer (aqueous essence). (A portion of the aqueous essence is used as a source of orange juice aroma and flavor volatiles for the method of the present invention). The remaining stripped juice is then concentrated (by heat) to the appropriate amount of the concentrated juice. This concentrated juice can be used in the method of the present invention.

Most concentrated orange juices are obtained by evaporative concentration. However, freeze concentration can also be used to obtain concentrated orange juice useful. Freeze concentration typically involves passing the serum portion

exchanger to form substantially pure ice crystals which are the preferred freeze concentration method is disclosed in U.S. Pat. 1983, which is incorporated by reference. Unlike evaporative obtained by freeze concentration typically contains the aromatic

parated from the concentrated juice. A
74,865 to Strobel, issued February 22,
centration, concentrated orange juice
or volatile as well.

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2. Other Beverages and Beverage Concentrates

The other beverages and concentrates of the present invention are formulated techniques. Although noncarbonated beverages are given particular emphasis is given to the making of carbonated beverages. Carbonated beverage making techniques, when appropriate, are used for carbonated beverages. Also, while the following description is directed to diet beverages containing noncaloric sweeteners can also be prepared.

15 In making a sugar-sweetened carbonated beverage, a be
verage concentrate typically contains the emulsified or water
and weighting agents if needed, any color desired and suff.
formed, sugar and water are then added to make a beverage by
an appropriate quantity of water to form the finished beverage
about 2:1 (3X syrup) to about 4:1 (5X syrup). Carbon dioxide is
20 added to the beverage syrup or into the drinkable beverage to a
can then be placed in a container such as a bottle or can and
In Soft Drinks Technology, Vol. 1, (Applied Science Publishers
by reference), for a further description of beverage making, in .

25 The amount of carbon dioxide introduced into the brewing system used and the amount of carbonation desired. Usually invention contain from about 1.0 to about 4.5 volumes of carbon dioxide, contain from about 2 to about 3.5 volumes of carbon dioxide.

The calcium source(s) (e.g. calcium carbonate, calcium 30 (e.g., citric, malic, and phosphoric) can be added at various syrup-carbonated beverage making process. The calcium same point in this process, but can also be added at different are included during preparation of the beverage concentrate c

35 Specific Embodiments of Beverages, Beverage Concentrates and the Present Invention

The following are specific embodiments of beverages, beverage mixtures and processes for their preparation, in accordance with the present invention:

can be prepared by standard beverage in the scope of the present invention. It should be understood, however, that ifified, are also applicable to noncarbene to sugar containing beverages, d by appropriate modification.

concentrate is usually formed. This
flavors, emulsion stabilizing agents,
preservatives. After the concentrate is
this beverage syrup is then mixed with
a weight ratio of water: syrup is from
introduced either into the water mixed
carbonation. The carbonated beverage
sealed. See L. F. Green, Developments
978), pp. 102-107 (herein incorporated
in the process for carbonation.

can depend upon the particular flavor carbonated beverages of the present oxide. Preferred carbonated beverages

and calcium chloride) and the acids in this beverage concentrate-beverage and acids are preferably added at the Usually, the calcium source and acids preparation of the beverage syrup.

Methods for Making Same According to

syrups and methods for making same

45 A cola-flavored beverage syrup was prepared from the ic.

Ingredients:

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Ingredient	Amount
Water	242
Calcium hydroxide	0.15
Calcium chloride dihydrate	0.05
Calcium sulfate dihydrate	1.0
Phosphoric acid (85%)	0.2
High fructose corn syrup 55	22.4
Cola flavor and caramel	4.0
Total	48.0

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The ingredients were mixed together to form the syrup. The syrup was added to 10 oz. bottles (90 g. of syrup in each bottle). The bottles were then cooled to 34° F. Carbonated water (4.95 volumes CO₂) was added to make a final volume in each bottle of 10 oz.

Embodiment 2

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A lemon/lime-flavored beverage was prepared from the following ingredients:

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Ingredient	Amount
Water	128
Calcium carbonate	1.0
Calcium sulfate	0.5
Calcium chloride dihydrate	0.5
Citric acid (anhydrous)	0.5
High fructose corn syrup 55	21.0
Total	150.0

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The above ingredients were mixed together and then 1.67 ml of lemon/lime flavor and 2.4 ml of color were added and mixed. The beverage was added to 16 oz. bottles (about 500 g. in each bottle). The bottles were carbonated to 3.5 volumes CO₂. The beverage had a pH of 3.56.

Embodiment 3

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The lemon/lime-flavored beverage was prepared from the following ingredients:

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Ingredient	Amount
Water	100
Calcium hydroxide	0.5
Calcium chloride dihydrate	0.5
Calcium sulfate	0.5
Citric acid (anhydrous)	0.5
Malic acid	0.5
High fructose corn syrup 55	14.0
Total	100.0

The above ingredients were mixed together and then added to 16 oz. bottles (about 500 g. in each bottle). To each bottle was added 0.53 ml of lemon/lime flavor and 0.7 ml of color. The bottles were then carbonated to 3.0 volumes CO₂.

For Embodiments 1 to 3, the level of calcium, total acids and chloride in the beverage is shown in the following table:

Embodiment	Calcium (%)	Total Acids (%)	Chloride (%)
1	0.055	0.111	0.024
2	0.060	0.25	0.027
3	0.056	0.192	0.024

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Embodiment 4

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An acid/calcium mixture comprising 275 lbs. of tap water, 5.9 lbs. of calcium hydroxide and 2.89 lbs. of calcium sulfate dihydrate was prepared in a stainless steel tank. In a separate blending tank, 450 lbs. of 65° Brix orange juice concentrate was blended with 1400 lbs. of water. The acid/calcium mixture was added to the large tank containing diluted concentrate. More water was then added to provide a juice solids content of 14° Brix. The acid/calcium mixture (2250 lbs.) was pasteurized using a Crepaco Ultratherm Infusion Heater at a temperature of 230° F for 2 to 4 seconds in the Infusion Heater. The pH of pasteurized juice was 3.85. The inside wall of the Infusion Heater was inspected after the run. No precipitate or deposit of calcium salt was observed.

In a separate control run, an acid/calcium mixture comprising 0.74 lbs. of citric acid and 7.38 lbs. of calcium hydroxide was prepared in a stainless steel tank. The diluted juice/acid/calcium mixture was pasteurized using a Crepaco Ultratherm Infusion Heater under the same processing conditions. The final pH of pasteurized juice was 4.15. Severe deposits of calcium salt was noticed inside the Infusion Heater after the run.

Both runs were prepared to deliver 300 mg. of calcium per 8 oz. of juice.

5.9 lbs. of malic acid, 0.59 lbs. of citric acid, 0.39 lbs. of citric acid, 5.2 lbs. of calcium hydroxide and 1.46 lbs. of calcium sulfate (anhydrous) was prepared in a stainless steel tank. One half of the acid/calcium mixture was added to the large tank containing diluted concentrate. The acid/calcium mixture was then heated in the Infusion Heater at a temperature of 230° F for 2 to 4 seconds in the Infusion Heater. The pH of pasteurized juice was 3.85. The inside wall of the Infusion Heater was inspected after the run. No precipitate or deposit of calcium salt was observed.

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Embodiment 5

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An acid premix containing 275 lbs. of water, 7.6 lbs. of calcium hydroxide, 2.96 lbs. of calcium chloride dihydrate and 0.39 lbs. of citric acid was blended into a batch of orange juice as in Embodiment 4. The acid/calcium mixture was pasteurized using a Crepaco Ultratherm Infusion Heater in the same manner as in Embodiment 4. The final pH of the product was determined to be 3.65. No precipitate or deposit of calcium salt was observed inside the Infusion Heater after the run. This formula also delivered 300 mg. of calcium per 8 oz. of juice.

acid, 0.39 lbs. of citric acid, 5.2 lbs. of calcium hydroxide and 1.46 lbs. of calcium sulfate (anhydrous) was prepared in a stainless steel tank. One half of the acid/calcium mixture was pasteurized using a Crepaco Ultratherm Infusion Heater in the same manner as in Embodiment 4. The final pH of the product was determined to be 3.65. No precipitate or deposit of calcium salt was observed inside the Infusion Heater after the run.

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Embodiment 6

An acid/calcium mixture comprising 300 lbs. of distilled water, 7.6 lbs. of calcium hydroxide, 4.25 lbs. of calcium gluconate and 0.2 lbs. of citric acid was prepared in a stainless steel tank. One half of the acid/calcium mixture was blended into a batch of orange juice as in Embodiment 4. The acid/calcium mixture was then heated in the Infusion Heater at a temperature of 230° F for 2 to 4 seconds in the Infusion Heater. The acid/calcium mixture was then pasteurized as in Embodiment 4. The final pH of this product was 3.70. No precipitate or deposit of calcium salt was observed inside the Infusion Heater after the run. The product delivered 300 mg. of calcium per 8 oz. of juice. The flavor of the juice (without calcium salts) by untrained panelists.

0.2 lbs. of malic acid, 0.59 lbs. of citric acid, 0.39 lbs. of citric acid, 5.2 lbs. of calcium hydroxide and 1.46 lbs. of calcium sulfate one half of the acid/calcium mixture was added to the large tank containing diluted concentrate. Sufficient water was then added to the large tank containing diluted concentrate. The acid/calcium mixture was then heated in the Infusion Heater at a temperature of 230° F for 2 to 4 seconds in the Infusion Heater. The acid/calcium mixture was then pasteurized as in Embodiment 4. The final pH of this product was 3.70. No precipitate or deposit of calcium salt was observed inside the Infusion Heater after the run. The product delivered 300 mg. of calcium per 8 oz. of juice. The flavor of the juice (without calcium salts) by untrained panelists.

Claims

1. A calcium-supplemented beverage, which comprises:
 - (a) from 0.05% to 0.15% by weight solubilized calcium, preferably from 0.055% to 0.09% by weight;
 - (b) from 0.07% to 1% by weight of an edible acid component, preferably said acid component comprises citric acid, malic acid, or mixtures thereof, from 0.1% to 0.6% by weight;
 - (c) from 0.02% to 0.14% by weight sulfate;
 - (d) up to 0.05% by weight chloride;
 - (e) the amount of sulfate and chloride combined being no more than 0.10%;
 - (f) at least 0.5% of a flavor component; and
 - (g) from 1% to 14% sweetener, selected from sugar, high fructose corn syrup, a non-caloric sweetener, and mixtures thereof.
2. The beverage of Claim 1 which is carbonated with from 4.5 volumes of carbon dioxide, preferably from 2 to 3.5 volumes.
3. The carbonated beverage of Claims 1 or 2 wherein said 4.5 volumes of carbon dioxide, component comprises from 5% to 15% fruit juice by weight of the beverage.
4. A beverage concentrate in liquid form for preparing a drinkable beverage, which comprises:
 - (a) from 0.15% to 0.75% by weight solubilized calcium, preferably from 0.16% to 0.45% by weight;
 - (b) from 0.2% to 5% by weight of an edible acid component, preferably said acid component comprises citric acid, malic acid, or mixtures thereof, from 0.3% to 3% by weight;
 - (c) from 0.06% to 0.7% by weight sulfate;
 - (d) up to 0.25% by weight chloride;
 - (e) the amount of said sulfate and said chloride combined being no more than 0.5% by weight;
 - (f) at least 0.5% flavor component; and
 - (g) from 30% to 70% water.
5. The concentrate of Claim 4 which further comprises from 70% by weight sugar, preferably high fructose corn syrup.
6. A calcium-supplemented single-strength fruit juice beverage 70% by weight sugar, preferably comprises:
 - (a) from 0.05% to 0.26% by weight solubilized calcium, preferably from 0.10% to 0.20% by weight;
 - (b) from 0.4% to 4% by weight of an edible acid component, preferably from 0.6% to 2% by weight;
 - (c) from 0.02% to 0.1% by weight sulfate;
 - (d) up to 0.07% by weight chloride;
 - (e) the amount of sulfate and chloride combined being up to 0.12%;
 - (f) from 45% to 90% fruit juice, preferably citrus juice, orange juice, or apple juice;
 - (g) a sugar content of from 2° to 16° Brix, preferably from 2° to 16° Brix.
7. The beverage of Claim 6 wherein said acid component comprises a mixture of citric acid, malic acid and gluconic acid.
8. A calcium-supplemented fruit juice concentrate, which comprises:
 - (a) from 0.15% to 1.30% by weight solubilized calcium, preferably from 0.3% to 1.0% by weight;
 - (b) from 1.2% to 20% by weight of an edible acid component, preferably from 1.8% to 10% by weight;
 - (c) from 0.06% to 0.5% by weight sulfate;
 - (d) up to 0.35% by weight chloride;
 - (e) the amount of said sulfate and said chloride combined being up to 0.5% by weight;
 - (f) at least 45% fruit juice, preferably citrus juice; and
 - (g) a sugar content of from 6° to 75° Brix.
9. The concentrate of Claim 8 which has been frozen and which comprises at least 95% of the concentrate.
10. The concentrate of Claim 8 wherein said orange juice concentrate comprises from 50% to 90% of the



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DOCUMENTS CONSIDERED TO BE RELEVANT		Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. CL.3)
Category	Citation of document with indication, where appropriate, of relevant passages		
X	EP-A-0 227 174 (PROCTER & GAMBLE CO.) * page 11, embodiment 5; claims 1-10 ---	5,9	A 23 L 2/26
X,P	EP-A-0 244 903 (PROCTER & GAMBLE CO.) * page 11, embodiment 1; claims 1-19 ---	5,9	
A	US-A-3 657 424 (C.O. AKTINS et al.) * claims 1-9 ---	4	
D,A	US-A-4 448 770 (E.E. EPTING) * abstract *		
D,A	US-A-4 322 407 (S.Y. KO) * claims 1-9 *		
		TECHNICAL FIELDS SEARCHED (Int. CL.3)	
		A 23 L 2/00	
The present search report has been drawn up for all claims			
Place of search	BERLIN	Date of completion of the search	Examiner
		27-10-1988	SCHULTZE D
CATEGORY OF CITED DOCUMENTS		T : theory or principle E : earlier patent or publication, after the filing date D : document of the same category L : document of a different category, but of relevance & : member of a family of documents P : intermediate document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background : non-written disclosure P : intermediate document		Verifying the invention &, but published on, or application or reasons patent family, corresponding	